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26200 7590 07/08/2009

FISH & RICHARDSON P.C.
P.O BOX 1022
MINNEAPOLIS, MN 55440-1022

EXAMINER

BARON, HENRY

ART UNIT

PAPER NUMBER

2416

DATE MAILED: 07/08/2009

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/767,067	01/28/2004	Hemanth Sampath	MP0396	5464

TITLE OF INVENTION: SCALABLE SPACE-FREQUENCY CODING FOR MIMO SYSTEMS

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	\$1510	\$0	\$0	\$1510	10/08/2009

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

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B. If the status above is to be removed, check box 5b on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above, or

If the SMALL ENTITY is shown as NO:

A. Pay TOTAL FEE(S) DUE shown above, or

B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check box 5a on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and 1/2 the ISSUE FEE shown above.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

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Complete and send this form, together with applicable fee(s), to: **Mail Stop ISSUE FEE**
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I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)

(Signature)

(Date)

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nonprovisional	NO	\$1510	\$0	\$0	\$1510	10/08/2009

EXAMINER	ART UNIT	CLASS-SUBCLASS
BARON, HENRY	2416	370-206000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

"Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. Use of a Customer Number is required.

2. For printing on the patent front page, list

- (1) the names of up to 3 registered patent attorneys or agents OR, alternatively,
- (2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____

2 _____

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3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY AND STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent): Individual Corporation or other private group entity Government

4a. The following fee(s) are submitted:

4b. Payment of Fee(s): (Please first reapply any previously paid issue fee shown above)

- Issue Fee
- Publication Fee (No small entity discount permitted)
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Payment by credit card. Form PTO-2038 is attached.

The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. Change in Entity Status (from status indicated above)

a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.

b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

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Date _____

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This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS; SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

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FISH & RICHARDSON P.C. P.O BOX 1022 MINNEAPOLIS, MN 55440-1022				EXAMINER BARON, HENRY
				ART UNIT 2416 PAPER NUMBER DATE MAILED: 07/08/2009

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b) (application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 871 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 871 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (<http://pair.uspto.gov>).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

Notice of Allowability	Application No. 10/767,067	Applicant(s) SAMPATH ET AL.
	Examiner HENRY BARON	Art Unit 2416

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTO-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. This communication is responsive to 3/27/2008.
2. The allowed claim(s) is/are 1 - 4, 6 - 17, 19 - 28, 30 - 40, 42 - 47, 73 - 75, and 77 - 87, 89 - 94.
3. Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 - a) All b) Some* c) None of the:
 1. Certified copies of the priority documents have been received.
 2. Certified copies of the priority documents have been received in Application No. _____.
 3. Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
5. CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
 - (a) including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached 1) hereto or 2) to Paper No./Mail Date _____.
 - (b) including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. Notice of References Cited (PTO-892)
2. Notice of Draftsperson's Patent Drawing Review (PTO-948)
3. Information Disclosure Statements (PTO/SB/08),
Paper No./Mail Date _____
4. Examiner's Comment Regarding Requirement for Deposit
of Biological Material
5. Notice of Informal Patent Application
6. Interview Summary (PTO-413),
Paper No./Mail Date _____.
7. Examiner's Amendment/Comment
8. Examiner's Statement of Reasons for Allowance
9. Other _____.

/H. B./
Examiner, Art Unit 2416

/Seema S. Rao/
Supervisory Patent Examiner, Art Unit 2416

Detailed Action

SCALABLE SPACE-FREQUENCY CODING FOR MIMO SYSTEMS

Response to Arguments/Remarks

1. Claims 1 – 94 are currently pending in the application.
2. In response to arguments made by Applicant on 3/27/2009, Examiner finds that the claims, as amended below, are in condition for allowance.

Examiner Amendment

3. With regards to the claims and specification, an examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.
4. Authorization for this examiner's amendment was given by Mark D. Kirkland (Reg. No. 40,048) on May 29th, 2008.
5. Kindly amend claims 1, 4, 8, 11 – 14, 19, 21, 23 – 26, 28, 34, 36 – 37, 44, 47, 73, 75, 83 – 84, 89, 91, and 93 – 94 as set forth below. Claims 5, 18, 29, 41, 48 – 72, 76, and 88 are cancelled. All pending claims are reproduced below, with changes in the amended claims shown by underlining (for added matter) and strikethrough/ brackets (for deleted matter).

CLAIMS

1. (Currently amended) A method comprising:
receiving a selected spatial multiplexing rate, the spatial multiplexing rate corresponding to a number of data streams for transmission on a like number of antennas
plurality of mapping permutations; and

for a plurality of data tones, applying [[the]] a plurality of mappings mapping permutations in an alternating manner to map one or more of a plurality of data symbols to a-plurality of the antennas, wherein the plurality of mappings include up to

$$\binom{M_T}{M} = \frac{M_T!}{M!(M_T - M)!} \text{ number of mappings, wherein } M \text{ is the spatial multiplexing rate}$$

and M_T is the number of antennas.

4. (Currently amended) The method of claim 3, further comprising:
transmitting the coded OFDM symbol on the plurality of antennas.

5. (Canceled)

6. (Currently amended) The method of claim 1, wherein the spatial multiplexing rate is selected from a plurality of available spatial multiplexing rates corresponding to the number of the plurality of antennas.

8. (Currently amended) The method of claim 1, wherein the mappings mapping permutations are applied to the plurality of data tones in a cyclical manner.

11. (Currently amended) The method of claim 1, further comprising:
transmitting the plurality of data symbols from the plurality of antennas at a substantially equal power for each antenna of said plurality of antennas.

12. (Currently amended) The method of claim 1, wherein said applying comprises mapping said one or more of the plurality of data symbols to the plurality of antennas for each of the plurality of data tones using less than a plurality of available tone-antenna combinations.

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13. (Currently amended) The method of claim 1, wherein said applying comprises mapping a same mapping permutation to the plurality of antennas for a plurality of adjacent tones.

14. (Currently amended) A method comprising:
receiving a space frequency coded symbol from a plurality of antennas, the space frequency coded symbol including a plurality of data tones,
wherein the plurality of data tones includes one or more of a plurality of data symbols mapped according to a plurality of mappings mapping permutations applied in an alternating manner, the plurality of mappings including up to $\binom{M_T}{M} = \frac{M_T!}{M!(M_T - M)!}$
number of mappings, wherein M is a selected spatial multiplexing rate and M_T is a number of the plurality of antennas, and
wherein the spatial multiplexing rate corresponds to a number of data streams used for transmission on a like number of antennas plurality of mapping permutations correspond to a selected spatial multiplexing rate; and
decoding the space frequency coded symbol.

18. (Canceled)

19. (Currently amended) The method of claim 14, wherein the spatial multiplexing rate is selected from a plurality of spatial multiplexing rates corresponding to the number of the plurality of antennas.

21. (Currently amended) The method of claim 14, wherein the mappings mapping permutations are applied to the plurality of data tones in a cyclical manner.

23. (Currently amended) The method of claim 14, wherein said receiving comprises receiving the space frequency coded symbol with substantially maximum spatial diversity on the plurality of antennas for the selected spatial multiplexing rate.

24. (Currently amended) The method of claim 14, wherein said receiving comprises receiving the space frequency coded symbol at a substantially equal power for each antenna of said plurality of antennas.

25. (Currently amended) The method of claim 14, wherein the space frequency coded symbol includes a plurality of data symbols mapped according to the mappings plurality of mapping permutations applied in an alternating manner for a plurality of adjacent tones.

26. (Currently amended) An apparatus comprising:
a demultiplexer operative to demultiplex a plurality of data symbols in an input stream;

a mode selector operative to select a spatial multiplexing rate from a plurality of available spatial multiplexing rates, the selected spatial multiplexing rate corresponding to a number of data streams for transmission on a like number of antennas to the plurality of data symbols and a plurality of mapping permutations; and

a coding module operative to space frequency code a symbol for transmission, the coding comprising, for a plurality of data tones, applying [[the]] a plurality of mappings mapping permutations in an alternating manner to map one or more of the plurality of data symbols to a plurality of the antennas;

$$\text{wherein the plurality of mappings include up to } \binom{M_T}{M} = \frac{M_T!}{M! (M_T - M)!} \text{ number}$$

of mappings, wherein M is the spatial multiplexing rate and M_T is the number of antennas.

28. (Currently amended) The apparatus of claim 27, further comprising:
a transmission module operative to transmit the coded OFDM symbol on the plurality of antennas.

29. (Canceled)

31. (Currently amended) The apparatus of claim 26, wherein the coding module is operative to apply the mappings mapping permutations to the plurality of data tones in a cyclical manner.

34. (Currently amended) The apparatus of claim 26, further comprising:
a transmit module operative to transmit the symbol from the plurality of antennas at a substantially equal power for each antenna of said plurality of antennas.

36. (Currently amended) The apparatus of claim 26, wherein the coding module is operative to map one or more of the plurality of data symbols to the plurality of antennas using a same mapping permutation for a plurality of adjacent tones.

37. (Currently amended) An apparatus comprising:
a receiver operative to receive a space frequency coded symbol from a plurality of antennas, the space frequency coded symbol including a plurality of data tones,
wherein the plurality of data tones includes one or more of a plurality of data symbols mapped according to a plurality of mappings mapping permutations applied in an alternating manner, and

wherein the plurality of mappings include up to $\binom{M_T}{M} = \frac{M_T!}{M! \times (M_T - M)!}$ number

of mappings, wherein M is a selected spatial multiplexing rate and M_T is a number of the plurality of antennas, wherein the spatial multiplexing rate corresponds to a number of data streams transmitted from a like number of antennas plurality of data symbols and the plurality of mapping permutations correspond to a selected spatial multiplexing rate; and

a decoder operative to decode the space frequency coded symbol.

41. (Canceled)

44. (Currently amended) The apparatus of claim 37, wherein the mappings mapping permutations are applied to the plurality of data tones in a cyclical manner.

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47. (Currently amended) The apparatus of claim 37, wherein the space frequency coded symbol includes one or more of the plurality of data symbols mapped to the plurality of antennas using a same mapping ~~permutation~~ for a plurality of adjacent tones.

48 – 72 (Cancelled)

73. (Currently amended) An apparatus comprising:
means for demultiplexing a plurality of data symbols in an input stream;
means for selecting a spatial multiplexing rate from a plurality of available spatial multiplexing rates, the selected spatial multiplexing rate corresponding to a number of data streams for transmission on a like number of antennas plurality of data symbols and a plurality of mapping permutations; and
means for space frequency coding a symbol for transmission, the coding comprising, for a plurality of data tones, applying [[the]] a plurality of mappings mapping permutations in an alternating manner to map one or more of a plurality of data symbols to the a plurality of antennas;

wherein the plurality of mappings include up to $\binom{M_T}{M} = \frac{M_T!}{M! \times (M_T - M)!}$ number of mappings, wherein M is the selected spatial multiplexing rate and M_T is the number of antennas.

75. (Currently amended) The apparatus of claim 74, further comprising:
means for transmitting the coded OFDM symbol on the plurality of antennas.

76. (Canceled)

78. (Currently amended) The apparatus of claim 73, wherein the means for space frequency coding is operative to apply the mappings mapping permutations to the plurality of data tones in a cyclical manner.

81. (Currently amended) The apparatus of claim 73, further comprising:
means for transmitting the symbol from the plurality of antennas at a substantially equal power for each antenna of said plurality of antennas.

83. (Currently amended) The apparatus of claim 73, further comprising means for mapping one or more of the plurality of data symbols to the plurality of antennas using a same mapping permutation for a plurality of adjacent tones.

84. (Currently amended) An apparatus comprising:
means for receiving a space frequency coded symbol from a plurality of antennas, the space frequency coded symbol including a plurality of data tones,

wherein the plurality of data tones includes one or more of a plurality of data symbols mapped according to a plurality of mappings mapping permutations applied in an alternating manner, the plurality of mappings including up to $\binom{M_T}{M} = \frac{M_T!}{M!(M_T - M)!}$
number of mappings, wherein M is a selected spatial multiplexing rate and M_T is a number of the plurality of antennas, and

wherein the spatial multiplexing rate corresponds to a number of data streams used for transmission on a like number of antennas plurality of data symbols and the plurality of mapping permutations correspond to a selected spatial multiplexing rate; and
means for decoding the space frequency coded symbol.

88. (Canceled)

89. (Currently amended) The apparatus of claim 84, wherein the spatial multiplexing rate is selected from a plurality of spatial multiplexing rates corresponding to the number of the plurality of antennas.

91. (Currently amended) The apparatus of claim 84, wherein the mappings mapping permutations are applied to the plurality of data tones in a cyclical manner.

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93. (Currently amended) The apparatus of claim 84, wherein the space frequency coded symbol symbols is coded using less than a plurality of available tone-antenna combinations.

94. (Currently amended) The apparatus of claim 84, wherein the space frequency coded symbol includes one or more of the plurality of data symbols mapped to the plurality of antennas using a same mapping permutation for a plurality of adjacent tones.

Allowable Subject Matter

6. After a further search and thorough examination of the present application and in view of the applicant's arguments filed on 3/27/2009, claims 1 – 4, 6 – 17, 19 –28, 30 – 40, 42 – 47, 73 – 75, and 77 – 87 and 89 – 94 are allowable.

7. The following is a statement of reasons for the indication of allowable subject matter:

8. The prior art teaches of mapping symbols using pure multiplexing or pure diversity, but none of the prior art references teaches of using cyclic permutations to effect a scalable space-frequency coding for MIMO systems. The Examiner found, in any MIMO system, the only reference (not prior art) that taught of mapping symbols to antennas and tones was Ihm et al (U.S. Patent Application 20080267318) Figures 18 and 19, which is incorporated here as reference. However, Ihm does not teach of Applicant's permutations.

Conclusion

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to HENRY BARON whose telephone number is (571)270-1748. The examiner can normally be reached on 7:30 AM to 5:00 PM E.S.T. Monday to Friday.

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10. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Seema Rao can be reached on (571) 272-3174. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

11. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Henry Baroni/
Examiner, Art Unit 2416
HB

/Seema S. Rao/

Supervisory Patent Examiner, Art Unit 2416